



Fireflying

Hunting the *Photinus greeni*

By Lee Stephanie Roscoe



Looking into my backyard one June evening, I spotted them. Little blinking lights twinkling all around. I love it when the fireflies come out— they herald that summer has officially arrived.

Watching the lights blink here and there, it occurs to me that it looks like Morse code. And in a way, it is—these little insects are communicating with each other, signaling to attract mates. What's amazing is that despite the fact there are approximately 175 different species of fireflies in the U.S., all flashing and blinking in a beautiful, yet seemingly arbitrary display, most are able to easily connect with their own species.

That's because what appears random to us, is actually a well-choreographed show, with each species' flashes varying in color, length, and pattern. This evolutionary adaptation has enabled fireflies to survive throughout the years.

But fireflies may be in trouble. Over the past few decades, firefly populations have been declining. I noticed it in my neck of the woods, and wanted to learn more about these fascinating bioluminescent beetles (yes, despite their name, they are beetles, not flies). In my research, I discovered a program called "Firefly Watch" (see "Firefly Watcher" on page 27) being run by the Boston Museum of Science, and decided to contact Kristian Demary, one of the biologists involved with the project.

Agreeing to let me tag along with her in the field, Kristian met me in a local park on Midsummer's Eve, shortly after dusk. It was misting and she was anxious to set out to study fireflies.

We covered our bare skin in bug

repellant to guard against mosquitoes, but made sure not to leave any on our hands to protect any fireflies we might handle. Kristian donned a miner's lamp and off we went.

We were on the hunt for *Photinus greeni* (Kristian pronounced it "green eye"), a firefly that only flashes from about 8:20 p.m. to 9:45 p.m. As we walked, Kristian described how firefly species have evolved to separate themselves "spatially and temporally" to avoid confusion between species emitting similar flash patterns. She explained how the various species divide up the night as well as the summer season, each appearing for about an hour every evening over the course of a fortnight, and only in certain temperatures. The hotter and moister the night, the faster most fireflies will flash. Kristian also said that while all fireflies use moist areas, they will separate into niches. For instance, *Pyractomena* spp. prefer stream banks, *Photuris* spp. prefer trees, and *Photinus* spp. prefer wet grassy areas.

Arriving at our destination, Kristian flashed her penlight on and off in the correct code to mimic a male *greeni* seeking out a mate: two short pulses with a pause of about one to four seconds between the set. It didn't take long before a light went off in the grass. Kristian bent to the ground, shining the blue miner's lamp down at the grass. She quickly located the *Photinus* female, not much bigger than a large black ant, and pointed it out to me.

Firefly, shown larger than life
Photinus, sp.—adult



As we continue up the road flashing, Kristian tells me about her background. An evolutionary biologist, she is studying fireflies in part to try and find out how mate selection and predation avoidance drives evolution, and how they are reflected in morphology and behavior. In other words, how does form affect function, and function form? How do females select

females perch on nearby vegetation. Not so with *Photuris*; females will fly and sometimes mimic the attracting flash code of a consenting *Photinus* female to lure unsuspecting *Photinus* males to their death. Consuming male *Photinus* provides nourishment for *Photuris*'s eggs, and makes the adults toxic to predators.

Though certain flashless fireflies may emerge at the end of winter, most flashing species in the northeast come out between Memorial Day and Labor Day.

mates? Do females have a post-mating choice whereby they can actually store and determine which sperm is best, and use it to produce offspring? What do the males do to make certain their sperm is chosen?

Kristian confesses to me that it was William Rice's pioneering work on sexual conflict and controlling behaviors in *Drosophila* spp. (fruit flies) which was the reason she decided to become an evolutionary biologist while still an undergraduate at Mount Holyoke. She wanted to apply Rice's findings to fireflies, to see if there were parallels.

"I just saw *Photuris* up in the trees," Kristian whispers. We are quiet.

Photuris is in many ways the real star of the firefly world; it's a bully, the predator who sets the rules. In most species of fireflies, it's largely the males that fly around flashing while the

A truck drives by and a male park ranger sticks his head out asking if we're OK. It must look pretty weird, two females by the road flashing a dainty pen light on and off in Morse code.

"We're looking for fireflies," Kristian assures him before he drives off.

Kristian then pulls out a thermometer and comments, "Good. It's above 60°F. *Greeni* won't come out below that." Then she explains that we still may not see a lot of *Photinus* flashes because if it spots *Photuris*, it stops to avoid being predated.

"Is it only *Photuris* females which are cannibals?" I ask.

"No. We had one *Photuris* male in the lab suck out *Photinus* blood."

"Oh. And why are *Photuris* males as big as the females?"

"Perhaps to avoid predation by its own female."



The firefly, also known as the lightning bug, is actually neither a fly nor a bug, but a beetle. This particular firefly is called Say's firefly (*Pyroactomena angulata*), one of about 175 species of fireflies in the United States.

This leads to a discussion about the habits of other local species of fireflies and I learn that *Pyroactomena* comes out earlier in the spring than the two main players, perhaps avoiding predation by seasonality, as well as by tactics. *Pyroactomena* will dive down suddenly if attacked, and its flash code is sporadic. Since I've seen this species during the daytime in May, I ask her about timing.

"Everything's based on rainfall and temperature, so it will vary every single year. It's not a constant," Kristian says, careful to qualify everything she tells me. "Though certain flashless fireflies may emerge at the end of winter, most flashing species in the northeast come out

Firefly Facts

- Are beetles, not flies.
- Prefer it hot and humid; will not flash under 54°F. The more intense the weather, the more they light up.
- Prefer moist areas—wet meadows, forest edges, farm fields with tall grass, and wild bog, marsh, stream and lake edges.
- Spend most of their lives (up to two years) as grubs. The nighttime lights generally occur during the last two weeks of their lives.
- All firefly larvae (called glow worms) glow, but not all adult fireflies glow or flash. Light is created by an enzyme in the firefly's tail that drives a chemical reaction.
- Approximately 175 species of fireflies occur in the U.S.
- Species' flash displays vary in color, length, and pattern of repetition from each other.





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The *Photinus* female is not much bigger than a large black ant.

between Memorial Day and Labor Day. And the further north you go, the fewer species you find," she added.

Our attention is grabbed by a flash down low. *Photuris*. Kristian tells me that *Photuris* is more flexible in its habits as well as its flashes, flying both high and low through various habitats—on the prowl.

"Oops, one over there too," she whispers.

"Something's flashing high up in front of me," I say.

A small airplane growls overhead, prompting me to ask, "Do fireflies ever flash at plane lights?"

"The females will flash at anything if they're desperate enough: my head lamp, headlights..." she says in her small, articulate voice.

"Desperation born of brevity?" I ask. (With only a fortnight in which to live, love, and leave offspring behind, I'd be desperate too!)

"Probably."

As we get into the car to explore some more, she tells me that the part of the firefly's back end that lights up is called a lantern and that the chemical reaction that makes it glow is called the luciferin-luciferase reaction. Although this chemical's primary function is to attract a mate, it also serves to warn predators that fireflies' bodies contain noxious chemicals.

We part after driving around in fog too thick to see any fireflies. I promise to send her a list of my favorite areas where I have seen the three different species together. I drive home in a quiet mood, pondering how such a small light can potentially illuminate so much, and feel happy that much remains a mystery.

Pulling into my driveway, I vow to continue to do my part to keep an eye on firefly populations—not that I need an excuse to go outside on a warm June evening and watch the twinkling spectacle that is fireflies. It's summer's light show of flash-dancing diamonds in the grassy fields.

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FIREFLY WATCHER

Don Salvatore wants fireflies to be around in a century. To that end, he and the Museum of Science in Boston, Massachusetts where he works, have teamed up with researchers from Tufts University and Fitchburg State College to conduct a firefly census as a means of tracking these amazing insects. Now in its second year, the census uses volunteers to observe and report on firefly activity in or near their backyards. Last year, there were 1,500 participants in more than 30 states east of the Rockies (fireflies do not shine west of them).

Firefly populations appear to be declining throughout the U.S. While no one knows for sure why, many feel that habitat change may play a key role. Fireflies are sensitive to habitat disturbance and to moisture levels in the soil. In addition, pesticides may be taking a toll on their numbers and researchers also suspect that artificial light, like streetlights, impacts a firefly's ability to find a mate.

Scientists hope the census will shed light on the geographic distribution of fireflies and their activity during the summer season.

Firefly watches occur at many environmental education centers. For more information on how to participate, visit www.mos.org/fireflywatch.